

Aspects of Science in Western Australia 1829-1979.
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History of zoology in Western Australia

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Abstract

Previous histories of zoology in Western Australia are cited (including those of Alexander, Glauert and Whittell) and the survey continued to the present day. Several periods of activity may be recognised, beginning with the anecdotal records left by the early, mainly Dutch, voyagers, followed by the more substantial ones of the professional naturalists of the English and French marine-exploring expeditions from the late 18th Century onwards. The first colonists in 1829 included many talented observers and collectors, largely amateur, but the next generation settlers were so occupied with subsistence problems that intellectual life ebbed, not to be revived until the late 1880s. Visiting and resident naturalists, and the establishment of the State Museum, resulted in a renewed flowering of zoological activity, often by interested laymen, and supported by private patrons. After World War I these were superseded by an increasing number of academically-trained zoologists, professionally employed and centred on the University of Western Australia and the Western Australian Museum. They added ecology and physiology to the classical-style studies in taxonomy and comparative anatomy and revived field surveys for the documentation of the fauna of the State.

Introduction

A detailed history of the progress of zoological discovery in Western Australia was prepared by W. B. Alexander (1914, 1916, 1916a, 1916b, 1917), the Cambridge zoologist, who was on the staff of the Western Australian Museum between 1912 and 1920. His meticulous studies summarised chronologically all publications dealing with events between 1618 and 1840, with some reference to an apocryphal account dating back to 1499, accepted by some historians but discounted by Alexander.

Major H. M. Whittell and I in our *Birds of Western Australia* (in its five revised editions between 1948 and 1976) expanded Alexander's treatment to modern times but restricting the coverage to ornithological discovery. In addition we divided the chronological account into three fairly well defined periods: (1) the period of the early travellers, 1618 to 1700, when laymen's accounts and anecdotal records predominated, mostly of little scientific merit; (2) the period of the great exploring expeditions, 1791-1826, when discoveries of considerable substance were made; and finally (3) the period of the settlement of the colony, from 1829 onwards. This last period was subdivided into four sections—that dealing with the pioneer observers, 1829 to 1839; that of the visit of John Gilbert and his contemporaries, 1839 to 1843; the so-called "barren years", between 1843 and 1887, and the modern period from 1887 onward.

In 1968 I brought Australian ornithological discovery as a whole into this framework (Serventy 1972) but pointed out that a "barren

period" hardly existed as such in south-eastern Australia. Intellectual life in Western Australia ebbed rather low after the comparatively brilliant era of the first colonists. This cultural decline, after the passing of the first generation of settlers—many of them well-educated gentry carrying on the interests of their class in England at the time—has been noted by historians in other disciplines. Thus Kornweibel (1973) in his history of music in Western Australia, refers to the "Doldrums" of the mid-century years and that the revival of musical appreciation did not really come into its own until the 1880's.

Various partial histories of the development of knowledge of the Australian fauna have appeared. One of the most substantial supplements to Alexander's general survey is that by Glauert (1950) on the marsupials of the State. He elaborated on Alexander's treatment, added omitted data and brought the history forward to the mid-1940's. Hedley (1916) summarised the growth of knowledge of the Mollusca of the State from 1801 to 1912. Australia-wide compilations, with marginal relevance to Western Australia, include Gilbert Whitley's summaries of researches (Whitley 1970, 1975). Important historical data are to be found, also, in specialised bibliographies, including that of Musgrave (1932) on Australian entomological writings between 1775 and 1930. Of particular value in this connection is Whittell's *Literature of Australian Birds* (1954) which, besides being an index of published information up to the year 1950, contains an historical account to 1850. Though it is essentially an ornithological history there are references to other animal groups.

In the present article only scanty references will be made to works already dealt with in Alexander's thorough surveys to 1840, but the few additions to his work, as the result of later discoveries of relevant literature, will be included. As this account is a history, not a complete index to publications on Western Australian zoology, minor or sporadic papers will not be referred to, unless they report something notable.

The period of the early voyages (1618-1728)

The published accounts of natural history observations during this period, mainly by Dutch voyagers between Holland and the East Indies, are more of curiosity value than of scientific worth. Alexander has listed all that are of any relevance to this State.

The ship's company of the *Batavia*, wrecked at the Abrolhos in 1629, were the first Europeans to study an Australian marsupial. The Tammar at the Wallaby Islands was reported on by Francisco Pelsaert. Some problems regarding the ornithology of these islands were resolved when Henrietta Drake-Brockman (1963) deduced that the *Batavia* was not wrecked on Pelsart Island as previously thought but in the Wallaby Group further north. Ornithologists had been puzzled why Pelsaert had not mentioned the enormous flocks of nesting terns and other seabirds on Pelsart Island. Actually he never visited it. Important new information on the zoology of the Southern Group of the Abrolhos Islands was found in the journal of Adriaen van der Graeff, the second mate of the *Zeeuwyck* which was wrecked on Pelsart Island in 1727. He was the first to indicate that the Wedge-tailed Shearwaters, on which the castaways subsisted, were migratory, first returning to the nesting islands during the third week in August (his actual first date of their arrival being August 20). This detail of the species' life history was not appreciated by modern ornithologists until our own times and it was generally believed that the birds were sedentary (Rogers 1975).

The first European to write on the Rottneest Quokka was Samuel Volckersen, captain of the *Waeckende Boey*, during his search in 1658 for survivors of *De Vergulde Draeck*, wrecked in 1656. The log of his first officer, Abraham Leeman, has been reviewed recently by Tyler and Ross (1977) who interpret the "gulls" on the islet at Sand Knoll Ledge, north of Cervantes, which Leeman's party ate, as fledgling Wedge-tailed Shearwaters.

Alexander (1914) has pointed out that the English translations of the probable meanings of birds names in the old Dutch documents, as given in standard works such as those by Heeres (1890) and Major (1859) "are frequently wrong, as is only natural, since neither of these authors were ornithologists". Alexander sought the advice of a Dutch naturalist, F. E. Blaauw, in correcting them and also gave renderings for the first time, of some Dutch names which Heeres and Major had left untranslated.

The period of the great marine exploring expeditions (1791-1826)

The series of great oceanic expeditions sent out principally by the governments of Great Britain and France began an era of scientific exploration which added notably to the accumulation of zoological knowledge of the Australian region. Captain James Cook and Sir Joseph Banks are the most celebrated individual figures characterising this period but they did not themselves visit the waters of Western Australia. However Banks' journal of his impressions of Batavia (now Jakarta) in Java gives an important contemporary view, scientific and social, of the situation in our near neighbour to the north (Beaglehole 1962).

The earliest of these expeditions to visit Western Australian seas was that in the vessels *Discovery* and *Chatham* in 1791. George Vancouver was in command and the naturalist was the eminent Archibald Menzies. The most productive was undoubtedly the French expedition in the *Naturaliste* and *Geographe*, 1801-1803, under the command of Nicolas Baudin. Alexander (1916) had an unbounded admiration of the ability and dedication of the principal naturalist, Francois Pèron ("as showing the zeal and energy of this great man . . .") but a rather different picture of Pèron is painted by his commander Baudin in the recently published translation of the latter's log (Cornell 1974). Nevertheless there can remain no doubt of the competence and excellent scientific work of Pèron and his associates.

The work of the several later expeditions surveying Western Australian waters, led by Flinders (1801), King (1818), de Freycinet (1818), Dumont d'Urville (1826) and Wickham and Stokes (1840 in the *Beagle*) has been reviewed by Alexander. All contributed to knowledge of marine and island zoology.

The last of the surveying vessels operating on the western coast was *H.M.S. Herald* (Captain Sir Henry Mangles Denham) which surveyed Shark Bay in 1858. The surgeon, Frederick Matthew Rayner, made important collections of bird specimens here and further north. Chronologically this expedition belongs to a later section in this history. But it may more properly take its place here. Denham is better known for his surveys in New Guinea and eastern Australian waters (Ingleton 1944).

The period of the pioneer settlers (1829-1842)

Both at the Swan River, and earlier at Port Jackson, the first arrivals among the settlers and Government officials exhibited a remarkable zest for natural history inquiry. Many had shared the vogue for natural history prevalent in England since the publication of Gilbert White's *Selborne* in 1789. A new fauna and flora excited latent tastes in such studies. In the east Government officials in the First Fleet were in the forefront in documenting the natural phenomena around them. The first book published about Australia after the settlement, Surgeon-General John White's *Journal of a Voyage to New South Wales* (1789), dealt extensively with the local fauna and flora,

illustrated by many hand-coloured copper engravings. Some of the Establishment officials became more interested in their natural history pursuits than in their official duties. This seemed to be the case with Colonel William Paterson, commander of the New South Corps when Governor Bligh was deposed: he was very greatly attached to botanical studies—and so highly regarded in this field as to be elected an F.R.S.

At the Swan River, as Alexander's literature review indicates, there was a correspondingly keen interest in natural things. Lindley's *A sketch of the vegetation of the Swan River Colony*, published within 10 years of the founding of the settlement, is a graphic illustration of how thoroughly the first settlers had set about botanical studies, largely stimulated, of course, by the presence among them of James Drummond. There is no similar published codification of zoological knowledge but it would be possible to compile one.

There was keen competition among some of the colonists for the natural history spoils available for the inquisitive and acquisitive. Drummond wrote rather petulantly to Sir Joseph Hooker at Kew that a visiting German naturalist, J. A. L. Preiss, who arrived at the Swan River in 1838 and stayed until 1842, was buying up natural history material from the local settlers which Drummond felt should be his prerogative. Preiss was an unusually productive collector: when he left for London he had a collection of 200 000 plants over 600 bird specimens and a big collection of mammals, reptiles, insects and other fauna. He had offered the collection earlier, in October 1838, to the Colonial Government for \$6 000, \$4 000 in "ready money" and the balance in the form of a grant of land, but apparently nothing came of the offer (Glauert 1948). The collections were dispersed over several European museums and were worked over by specialists in ornithology, mollusca and botany, but the whereabouts of much of the material is still unknown (Meise 1951). One interesting specimen probably collected by, or for Preiss, escaped proper scientific study until 1907 when Siebenrock, at the Vienna Museum described what was to become known as the celebrated Short-necked Tortoise, *Pseudemydura umbrina* (Glauert 1955). It had been misidentified by an earlier research worker and the assumption was that it had been part of an original Preiss collection. The species is now confined to two seasonal swamps at Bullsbrook. However, it would appear that at the time of the original Swan River settlement it had a more extensive range. The Sydney botanist Charles Fraser, who accompanied James Stirling in his 1827 reconnaissance of the Swan River, stated when at Upper Swan: "The ridges of the banks are perforated with immense numbers of deep pits, the origin or cause of which we could not at first ascertain. They proved to be made by the natives for the purpose of catching land tortoises, with which these ridges abound" (Hay 1906). This must refer to the Short-necked Tortoise, then aestivating underground in the vicinity of its winter swamps.

The most significant naturalist at the Swan River at this period was John Gilbert, an able collector sent out by John Gould then working on his monumental multi-volume work on the *Birds of Australia*. Gilbert laid the foundations of ornithological knowledge of the south-west of the State. He paid two extended visits: from March 1839 to January 1840 and from July 1842 to September 1843. Few new full species of birds have been found since his time and he was the discoverer of such distinctive new forms as the Noisy Scrub-bird, Western Bristle-bird and Western Whipbird, and provided important data bearing on the contraction of their ranges into the "inner" South-West since European settlement. Gilbert also collected marsupials for Gould. He is probably the only naturalist to have seen alive in its habitat the Broad-faced Potoroo, *Potorous platyops*, and he collected the type specimens of almost half of the species and subspecies of recent marsupials occurring in the south-west. Many of his field notes were used, wholly or in part, by Gould in his *Mammals of Australia*, often without acknowledgement. Gilbert's original notes, in letters to Gould and some notebooks, have been subsequently re-located at odd times and in various repositories and are still turning up (Chisholm 1964). The latest find was in a batch of papers found in the British Museum of Natural History, South Kensington by Ederic Slater of the CSIRO in 1973. His status as a mammal field worker is discussed by Whittell (1954). He joined Leichhardt's expedition in 1844 to Port Essington, to further his collection of natural history material. For his abilities he was promoted in the field to second in command but was killed by Aborigines on June 28, 1845.

Lieut. George Grey, later knighted during a distinguished career, as governor and statesman, in other States, New Zealand and South Africa, explored extensively in Western Australia between 1836 and 1840, collected actively for overseas specialists, and published his observations in two volumes (1841) which are a valuable account of zoological knowledge of the Colony in that period. Observations on the fauna are included in a chapter on the food and hunting of the Aborigines, and there is a catalogue of birds, reptiles and amphibia, with an account of some insects from King George Sound. There were eight plates of reptiles and amphibia and 11 figures of insects. Grey's book is reviewed by Alexander.

A wealth of natural history information is contained in the publications of George Fletcher Moore (1832, 1842, 1884 and various articles in the *Perth Gazette*). Moore was a substantial colonist from Ireland who emigrated in 1830 in the hope of obtaining an official legal appointment as well as becoming a landed proprietor. Before he returned to England in 1852 he had achieved both objectives—he had become the first judge in a civil court, Advocate-General, a member of both the Executive and Legislative Councils, and was acting Colonial Secretary on the death of Peter Broun, as well as being the owner of about 10 000 ha of land in fee simple

and several allotments in towns. His writings reveal him to be an unusually acute field naturalist.

Moore's *Descriptive Vocabulary* (1842) of the local Aborigines is not only a glossary of many terms in use in various places in the South-West, but so annotated as to provide natural history, anthropological and geological information in a succinct way. It is not wholly Moore's work. The manuscript had been placed in his hands "in a very crude state by Governor Hutt, that I should get it published in England." The data in it had been collected by Francis Armstrong, Sir George Grey, Charles Symmons, the Bussell brothers from the Vassé and an anonymous person who "assumed the name Lyon." After he had edited and enlarged the manuscript Moore commented that "I might fairly and truly use the familiar expression, 'Quorum pars magna fui'."

The letter-diaries (published in 1832 and 1884) contain more extended natural history information, which has been reviewed by W. B. Alexander. Information in some missing letters (e.g. in those of the latter half of 1833), and hence unavailable to Alexander, is contained, in part, in the *Perth Gazette* of the period. In the issue of February 1, 1834, in a report by Moore of an excursion which determined the connection of the Avon with the Swan River, there is botanical but no zoological information.

Moore was with Ensign Robert Dale when they collected the first specimen of the Numbat near Mt. Kokeby in September 1831.

The barren years (1843-c.1880)

With the passing of the first generation settlers and the activities of their descendants being almost wholly absorbed with economic survival there was comparatively little leisure or energy left to be devoted to such pursuits as natural history. However, some noteworthy projects were initiated by officers of the Imperial service and other visitors.

In January 1852 William Ayshford Sanford took up appointment as Colonial Secretary and remained until 1855. A Cambridge man, he was interested in ornithology and other zoological studies, becoming after his return to England a well-known palaeontologist, working with Professor Sir William Boyd Dawkins on the British Pleistocene Mammalia. In Perth his most noteworthy achievement, in zoology, was the organization of the Austin surveying expedition to the Murchison in 1854 and working up its natural history results (Austin 1855). This expedition was instrumental in the discovery of the Night Parrot near Mt. Farmer (Serventy 1968). Also Austin's journal shows that they saw the Ghost Bat *Macroderma gigas* at Mt. Kenneth, though this fact was not recognized until years later by Glauert (1950). This would be the first observation of the species in Australia, about a quarter of a century before Dobson formally described it from Queensland.

Another visitor to the State who published on the natural history of the country at this time was Bishop Rosendo Salvado, of New Norcia. His

book on Western Australia, with chapters on the flora and fauna, was published in Rome in 1851, five years after he had arrived in Western Australia. Its first English translation did not appear until 1977 (Stormon 1977). The zoological matter in the book is not of very great importance but some interesting direct personal observations are contained in it, intermingled with information garnered from other published accounts, not relevant to Western Australia. There are citations of names and affinities which are not always accurate. Present-day workers are puzzled at the origin of some of the scientific names used by Salvado. Some originate with George Fletcher Moore, 1842—*Anas novae-hollandiae* for the Black Duck and *Formica maxima* for the "Lion Ant" or Bullant. But *Pelecanus spectabilis* is a "new" name for the Pelican. It is still unknown how either Moore or Salvado came by these names. Father Stormon suggests that "*spectabilis*" might be a slip for "*conspicillatus*", the correct specific name for the Pelican.

Among the more valuable personal observations by Salvado is one worth repeating in full: "Not seldom in the winter season, that is, June and July, I have found birds big as a thrush, which had fallen to the ground benumbed by the bitter cold of the night; I would take them up in my hands and not let them go until they had recovered their natural warmth." Salvado has here clearly described a phenomenon, of over-night torpidity, which has only very recently come under the attention of Australian ornithologists (Serventy 1970, Ives 1973). The phenomenon must, however, be of very general occurrence, and will no doubt be the subject of many specialist studies in the future.

This generally bleak period of zoological enterprise was brightened somewhat in 1866 and again in 1868-69, when George Masters was sent by the Australian Museum, Sydney, on collecting trips to the south coast. He obtained several specimens of the now dwindling Noisy Scrub-bird and a large collection of mammals (listed by Glauert 1950).

This period may be said to merge with the next, the Modern Period, with the era of William Webb, of Albany. He worked in isolation from the main communities in Western Australia, but his collecting of animals and plants brought him into contact with eastern states specialists, including Baron von Mueller and W. S. Macleay, who had founded the Macleay Museum in the University of Sydney. Webb also sold natural history material to passengers on overseas ships calling at Albany. The well-known botanical-artist traveller, Marianne North, met him in 1880 and provided the information that Webb had been a convict and was married to an Aboriginal wife. After *The Albany Mail* began publication in 1883 Webb contributed a series of useful natural history articles, the ornithological ones of which are summarised by Whittell, who cited others by title (Whittell 1954).

The modern period (1887 onward)

Introduction

After the English ornithologist Thomas Carter arrived in Western Australia in 1887 there began an era of continuing activity in ornithological studies in the State and there was an accompanying crescendo of general zoological activity. Carter, a pastoralist by calling, was a talented amateur. However, he worked with professional ornithologists both in England and Australia. The important thing was that there was now to be a continuum of contact between ornithologists to the present day.

In addition a number of expeditions, from overseas and within Australia, were mounted to explore the natural history of the inland areas and some islands.

More organized scientific activity became possible when W. B. Alexander joined the scientific staff of the Western Australian Museum in 1912 and the University of Western Australia was founded in 1913, with Professor W. J. Dakin in the chair of biology. Later still, with the re-vitalising of the University Zoology Department by the arrival of Professor H. W. Waring in 1948, the building up of the CSIRO Divisions of Fisheries, Wildlife and Entomology, the appointment of Dr. W. D. L. Ride to the directorship of the Western Australian Museum and the setting up of research staffs in the Fisheries and Fauna (later Wildlife) Department, there was a spectacular upward spurt in the quantity and quality of zoological research. This is continuing with the increase in number of tertiary education institutions.

The Modern Period may be subdivided as follows: (1) the building-up era, to the first World War; (2) under the leadership of the University and Museum, from about 1912 to about 1950; and (3) the present-day era of sophisticated zoological research.

From the arrival of Thomas Carter to the eve of World War I, 1887-1912

Carter did extensive field work in the region of North West Cape, where his sheep station (Point Cloates) was situated (Vines 1968). He laid the foundations of ornithological knowledge of the North-West and early recognized the existence of opportunistic breeding dependent on rainfall. His work overlapped that of another English migrant to the State, who, like him, had had previous experience in modern ornithological practice at home. This was F. B. Lawson Whitlock whose collecting on behalf of various patrons extended knowledge of bird distribution and his material provided the basis for taxonomic work on subspeciation by Gregory Mathews in England. A Victorian ornithologist, A. J. Campbell, visited the southern part of the State in 1889 and a series of reports by him filled in important details of distribution at that time (Campbell 1890).

Two inland expeditions, organized from beyond the State, collected zoological material in the inland areas. The Elder Expedition of 1891 had as naturalist Richard Helms, a remarkably able and versatile German migrant whose collecting in several animal groups was the "chief source

of knowledge as to the fauna of the dry interior regions of Western Australia" (Alexander 1916). Helms later worked in Western Australia and between 1896 and 1900 was biologist to the Department of Agriculture. His publications on the East Kimberley and the Abrolhos Islands are particularly important. The other expedition, the Calvert Expedition of 1896 with G. A. Keartland as naturalist, was concerned mainly with ornithology.

Two expeditions from Scandinavia worked in the north of the State. Knut Dahl, a Norwegian, collected in Dampierland in 1895 and added to the knowledge of local birds and mammals (Glauert 1950, Dahl 1926). The Swedish Scientific Expedition of 1910-13, under E. Mjöberg, also worked in the Kimberley Division but as well visited the area between Perth and Albany. Its results were published in 32 parts of the *Svenska Vetenskapsakademiens Handlingar* between 1913 and 1922. The expedition ornithologist, R. Söderberg (1918) was the first to draw attention to a peculiar phenomenon of the arid areas of Australia—the simultaneous occurrence of moult and breeding—an adaptation consequent on irregular opportunistic breeding.

Two considerable British expeditions and one minor one visited the State in the early years of the present century. The era was dominated, to some extent, by Oldfield Thomas, the mammalogist of the British Museum, who was instrumental in setting up the Balston Expedition of the British Museum in 1904-1905 with G. C. Shortridge as collector. He worked in the southern part of the State, on birds and mammals, making substantial contributions to distributional knowledge (Ogilvie-Grant 1909, Shortridge 1909, Glauert 1934, 1950).

In 1912 P. D. Montague, a Cambridge zoologist, visited the Montebello Islands (Montague 1913). The general collections were worked on by specialists and published in the Proceedings of the Zoological Society of London in 1914—Hogg (spiders), Montague (birds, reptiles, fishes and some insects), Rathbun (crustacea), Iredale (molluscs) and Robson (cephalopods). Montague lost his life in World War I.

When Radcliffe-Brown, from Cambridge, visited the State in 1910 on an anthropological expedition, he was accompanied by a young Cambridge graduate, E. L. Grant Watson, as zoologist. Watson collected mainly insects and his account of the enterprise (Watson 1968) would interest present-day expedition members who work under grants or salaries with generous daily field allowances. Watson received no salary and was expected to pay his way by selling specimens he obtained to specialists. He had made arrangements, for example, to receive ten shillings for 20 specimens of beetles, more for any considered rare, and a pound for 12 fleas of any species!

The most productive expedition of this period was the Hamburg South-Western Australian Research Expedition of 1905, under Dr. W. Michaelsen and Dr. R. Hartmeyer. With the exception of the Swedish expedition of Dr. Mjöberg and Montague's Montebello expedition, this was the first fully professional scientific

expedition of this period—in point of time actually the first. The expedition was mainly concerned with invertebrates but collected also reptiles, amphibia and some fishes. The results worked on by teams of specialists appeared in *Die Fauna südwest-Australiens*, in 5 volumes from 1907 onwards (Michaelsen and Hartmeyer 1907-1930). Three reports on the results and abstracts of most of the first three volumes were published locally by Michaelsen (1908, 1911 and 1914). The reports of this expedition provide the first systematic studies of many important invertebrate groups including Annelida, Crustacea, Onychophora and others.

An important generalisation on the relations of the Western Australian fauna to that of the rest of Australia was made by Professor Baldwin Spencer, of the University of Melbourne, after reviewing the results of the Horn Scientific Expedition to Central Australia (Spencer 1896). He introduced the concept of the three faunas—Bassian, Eyrean and Torresian—which has been generally adopted ever since, with modifications (cf. Serventy and Whittell 1976, Serventy 1972, 1973).

From the long-term point of view the most significant happening in this epoch was the establishment of the natural history section of the Perth Museum in 1892 under the curator Bernard H. Woodward. In 1895 its name was changed to the Western Australian Museum (Woodward 1903). Woodward, director of the institution since 1890, energetically encouraged the building-up of its zoological collections even though he himself, primarily a geologist, was mainly concerned with the arts (he was director also of the Art Gallery). In 1894 the Museum engaged the services of a taxidermist O. H. Lipfert, an unassuming but extremely competent naturalist whose role has been generally underestimated. He trained J. T. Tunney as a field collector who between 1895 and 1906 made extensive collections of mainly birds and mammals throughout the State. Lipfert himself also collected widely, his last considerable expedition being with the Canning Stock Route reconditioning party between 1930 and 1931 when he was over 65. But his main occupation at the Museum was the setting up of the displays of mammals, birds and other exhibits in the public galleries. One of the most outstanding was the diorama of the animals near Perth which he set up at the turn of the century, long before such displays became general in overseas museums.

Woodward sought the aid of outside naturalists in running specialist museum activities. The most important was A. W. Milligan, a Perth law clerk, who between 1901 and 1908 held the appointment of Honorary Consulting Ornithologist. He went on numerous expeditions and described the new species of birds that came to the Museum, the most notable of which was the Black Grass-Wren from the Kimberley Division, collected by Dr. F. M. House in 1901 during the F. S. Brockman survey expedition. This bird, though sought for assiduously in the intervening years, was only rediscovered in 1968 by the

Harold Hall Expedition of the British Museum (Freeman 1970). Milligan made important, though often faulty, generalisations on bird distribution in the southern parts of the State.

Though he was not a zoologist on the Museum staff at this period mention should be made of the work of Ludwig Glauert between 1909 and 1915 on the cave fossils of the South-West. He captured the popular imagination by showing that such creatures as the Koala, Tasmanian Thylacine and Devil, wombats and other animals thought to be peculiar to south-eastern Australia, had peopled the South-West in Pleistocene and Sub-Recent times. His public lectures on the finds attracted influential audiences, including the Governor of the day. Glauert was transferred from the Geological Survey to the Museum in 1910 and his zoological work will be referred to in the next section.

Another zoological institution came into being in this period—the South Perth Zoological Gardens. The gardens were laid out by the first director, Lieut-Col. E. A. Le Souef in 1897. Le Souef was a member of the renowned zoological gardens family of Melbourne and his brother founded the zoological gardens in Sydney. The history of the South Perth institution and its zoological and acclimatisation activities has been written by Jenkins (1978).

Finally, the Fisheries Department was constituted, following a report on local fisheries administration by Lindsay Thompson, of New South Wales (Thompson 1898). The subsequent reports by the Chief Inspectors (Gale 1900-1911, Aldrich 1912-1933, Fraser 1938-1939), including those of their regional inspectors, Abjornsson and others, provide a wealth of data on the condition of the estuaries and other waters which have been undeservedly overlooked by later research workers. The second Chief Inspector, Fred Aldrich, who held office between 1911 and 1938, was as self-effacing a man as was Lipfert at the Museum, but had conducted useful investigations the results of which are still mostly concealed in departmental files. Chittleborough has recently published one of his pieces of work, on the marine crayfishes (Chittleborough 1967).

In addition to these departmental reports much informative data on fisheries are contained in the minutes of evidence of Parliamentary inquiries into various aspects of fishing, pearling and whaling (e.g. Baglin 1922, Daglish 1906, Holman 1915 and Leslie 1948-1949).

In this period, too, began the first of the State's natural history and biological societies. The earliest was a purely botanical group, the Mueller Botanical Society, founded in 1897, which in 1904 was enlarged in scope to become the Western Australian Natural History Society. In 1909 it was transformed again to become the Natural History and Science Society of Western Australia. All three bodies regularly published their proceedings and papers. In 1913, consequent on events which will be recounted in the next section, the Society became the Royal Society of Western Australia.

The ascendancy of the University and the Museum

Two events in 1912 and 1913 proved turning points in the advancement of zoological studies on modern lines in Western Australia. Bernard Woodward retired from the directorship of the Western Australian Museum in 1914. The post was not filled but the collections were placed in the custody of three Keepers. The Keeper of Zoology was Mr. W. B. Alexander, the Cambridge graduate already mentioned who had joined the museum staff as an assistant in 1912. Alexander vigorously expanded the collections, organized educational displays in the museum on modern lines and by his example stimulated modern ornithological field studies which had a permanent effect on his followers (Serventy 1967).

The other event was the appointment of Professor W. J. Dakin to the first chair of biology in the newly founded University of Western Australia in 1913. Dakin was a marine and freshwater biologist. He enthusiastically threw himself into local researches. In preliminary plankton surveys of the Swan River estuary (Dakin 1916), he established that the phosphorescence in the water was due to a tintinnid ciliate protozoan, that the common jellyfish, *Aurelia aurita*, produced large numbers of ephyrae in June and that it would be possible to work out the complete development of the Swan River prawn from a series of plankton catches—this last anticipation not being realised until recent studies by Fisheries Department biologists. In inland waters he investigated the phyllopods of ephemeral pools and worked on *Peripatus* in damp earth habitats. He organized two scientific expeditions to the Abrolhos Islands during 1913 and 1915, financed by the Percy Sladen Trust. The results were published in a series of papers in the Journal of the Linnean Society of London (Dakin 1916a and 1919, Alexander 1922, Fauvel 1922, Tattersall 1922, Hickson 1922, Clark 1923, Dendy 1924, O'Donoghue 1924). He worked in close co-operation with Alexander of the Museum and the two were involved with the Abrolhos expeditions. Unfortunately both left the State for other spheres in 1920.

It was during their period in Perth that Dakin and Alexander were associated with the evolution of the old Natural History and Science Society into the Royal Society of Western Australia. This happened in 1913. Dakin became the first president and Alexander the second secretary, following a short spell in that office by Mr. M. A. Browne.

After the departure of Dakin and Alexander their posts were filled, respectively, by G. E. Nicholls at the University, and by L. Glauert at the Museum. They did not form the same co-operative team as did Dakin and Alexander, but nevertheless both continued the research tradition laid out by their illustrious predecessors. Nicholls (a London University graduate) who held the biology chair from 1921 to 1947, was essentially a comparative anatomist of the classical school and the graduate research in his department was mainly taxonomic. His

own research interests were in the lower crustacea. He was stimulated by Glauert's discovery of a local species of the distinctive freshwater isopod, *Phreatoicus*, and came to specialise on the group, ultimately producing a notable monograph on the phreatoicids from the whole of Australia (Nicholls 1943, 1944). His research students and other associates worked on other crustacean groups. Earlier papers by Sayce (1903), Wolf (1911), who worked on the collections made by the Hamburg Expedition of 1905, and by Dakin (1914) had drawn attention to the rich and varied fauna of phyllopods occurring in the inland claypans and lakes. These were collected and came under study. Milner (1929) worked out a collection of anostracans made by Nicholls himself; K. C. Richardson made a study of conchostracans which remains in manuscript in the Zoology Department; a visiting Swedish specialist on the anostraca, Folke Lindner, was based at the Department in 1936 and 1937 and conducted extended field work which contributed to a substantial part of his massive world revision of the order (Lindner 1941). Nicholls' review (1933) of the fauna of Western Australia is a valuable pointer to the existence of a rich fauna of damp earth and aquatic invertebrates.

Glauert's activities at the Museum between the two world wars were severely hampered by reduced finances, made particularly acute by the Depression. He had to operate virtually single-handed and the widespread collecting which had been a feature of Museum practice before the first World War had to be suspended until revived again later under a new director. Glauert's difficulties during the period and his achievements in spite of them are reviewed in a valedictory article published when he retired from the Museum (Serventy 1957). One minor publication of his, a Museum leaflet proposing popular names for local mammals (Glauert 1928) attained almost instant success in popularising a new name for the Rottnest Island wallaby *Setonix brachyurus*. This animal had hitherto been referred to as the Short-tailed Wallaby in scientific literature and "Wallaby" by the public. Glauert selected the King George Sound Aboriginal name, Quokka, for it, though the Swan River native name was Ban-gap, or Bunkup as the White settlers varied its pronunciation. "Quokka" became so rapidly accepted, through Glauert's publicity (he was regularly interviewed by the daily press on current zoological news) that most people now consider this name to have been always in use.

This period may be said to mark the withdrawal of the amateur naturalist from his hitherto prominent role as leader in zoological studies in the State and his replacement, naturally enough, by the professional—the trained and better-informed staff and students of the new University, staff members of the Museum and of the scientific branches of State government departments. Later still academic qualifications became an almost essential requirement for entry to the professional ranks.

However, the value of the amateur did not disappear. His role changed. In 1924 an organization ostensibly catering for amateur naturalists was founded in Perth, the Western Australian Naturalists' Club, but it was not until nearly a quarter of a century later that it was able to produce a periodical, the *Western Australian Naturalist*, now in its 14th biennial volume. The Club did not solely remain the prerogative of the amateur, as popularly understood, but proved to be a happy amalgam of the activities of serious amateurs, professionals and interested laymen, continuing the British and European tradition of enrolling persons finding personal pleasure in the study of the natural sciences as well as earning their livelihood in them. The German word, *Liebhabelei*, aptly describes their pursuit. The history of the Club and its achievements has been written by Erickson (1964, 1974). The new role of the amateur in the modern order has been discussed by Serventy (1972, 1973).

Coincidental with these changes of emphasis between amateur and professional in the development of zoology in the State, which were subtle and gradual, was the disappearance of the private patron, or gentleman collector. In the absence of appropriate institutions these people had virtually subsidised natural history in the old days, not only by sending out collectors at their own expense as did John Gould in England and W. S. Macleay and H. L. White in New South Wales, but paid visiting and resident collectors for specimens. Both patron and field collector were dedicated to advancing natural history knowledge and commercial profit was a very low priority, if considered at all. The example given previously of how a keen young Cambridge graduate, E. L. Grant Watson, was able to come to Australia in 1910 for a pittance was not unique. That class of enthusiast has by no means disappeared, but changing opinions on collecting and the attitude of many Museums have contributed to a situation where natural history studies involving field collecting have become virtually a "closed shop" to institutions and their members.

Parallel with these changes and no doubt related to them in a subtle way, is the altered attitude of the public to Zoology in this State. Mr. Jenkins in his presidential address to this Society in 1965 (Jenkins 1965) drew attention to the fact that membership of the Royal Society remained virtually static between 1923 and 1965. However in earlier years the "influence they wielded was disproportionately large." He attributes this to the fact that in early years the membership ranks included most of the influential people of Perth—the leading statesmen, members of the judiciary, leading clergy and merchants and socially prominent citizens. In recent times membership is "attracting mainly working scientists." The annual general meetings and conversaciones used to be important events in Perth's social calendar and the Society's ordinary meetings were reported regularly and fully in the morning newspaper. A presidential address by Bishop (later Archbishop) Riley in 1907 was published in full and

other meetings might receive up to two columns of newspaper space. Other scientific news received similar treatment. Lectures at the Museum by Glauert in 1914 on the cave fossils of the South-West drew large audiences, which included the Governor, Sir Gerald Strickland, with extensive press coverage. Another lecture by Glauert to the Western Australian Naturalists' Club in 1925, introducing to the Perth public the concept of continental drift as an explanation of fauna distribution, occupied a full column. Interviews with Perth zoologists, such as Glauert and Lieut.-Col. E. A. Le Souef, of the South Perth Zoo, on contemporary zoological news were commonplace. In recent years such reports became brief and occasional, and usually restricted to bizarre happenings of the "man bites dog" category. But latterly the publicity tide shows signs of turning. Specialist reporters on the *West Australian* like Catherine Martin (medical biology), Alex Harris (general science) and Michael Zekulich (agricultural science) cover the local scientific scene intelligently and in depth.

The modern sophisticated period of research

As with the beginning of the previous epoch the present one, now in progress, coincided approximately with the appointment of new heads to the Zoology Department of the University of Western Australia (in Professor H. W. Waring) and of the Western Australian Museum (in Dr. W. D. L. Ride). The rejuvenation of research and exploratory activity in both institutions, made possible also by an increase in funding and in staff numbers, has been dramatic. This new epoch was also notable for the increased extension into this State of the research activities of the CSIRO (in fisheries and oceanography, wildlife and entomology) and the expansion of the research programmes within the State Departments of Agriculture and Fisheries and Wildlife. The progress in research activity was accelerated when additional tertiary educational institutions were formed—the Western Australian Institute of Technology and Murdoch University.

Professor Waring (Liverpool University), who joined the University Zoology Department in 1948, introduced physiological and ecological teaching and research into the University and stimulated an active group concerned with marsupial eco-physiology. This was centred on a biological research station established in 1954 at Rottneest Island with the Quokka as the main study animal. The project was extended to a field station at Jandakot. Waring's work was widened by A. R. Main's studies on the biology of frogs. Research students from this training centre now occupy important chairs and other senior posts throughout Australia as well as abroad.

Ride, fresh from a vigorous research school at Oxford on vertebrate biology, expanded the scope of the Museum. He demonstrated the truth of the principle, which Glauert had been unable or unwilling to grasp, that "people are able to create funds", if a worthwhile case can be made out to government treasuries or private

patrons. A large increase in funds became available to the Western Australian Museum which enabled the scientific staff to be vastly enlarged allowing an active resumption of the exploration work which had characterised the Museum between 1895 and 1906.

The Fisheries and Fauna (now Wildlife) Department became similarly rejuvenated under another like-minded individual. This was A. J. Fraser who came from the New South Wales Fisheries Department to be Chief Inspector at Perth in 1938—his title was later changed to Director. He was an administrative officer and not a biologist, but he had a remarkable insight into how such a department should develop as an effective instrument into the research and control of exploited natural resources. He created the department as it now is, with a trained research staff. In the early stages of the process he enrolled outside scientists in a committee to plan research enterprise, a body which has now become the W.A. Wildlife Authority within the Department. Working in concert with the Museum the Department has begun a systematic zoological survey of key faunal areas throughout the State. Publication of results are made by both institutions on a scale never attempted in the past.

The relevant activity in the zoological field, within the Department of Agriculture, concerns investigations on species considered harmful to the farming and pastoral industries. The work is based on a modern laboratory complex at Forrestfield.

The major achievement of the CSIRO in terrestrial zoology was the establishment of the Wildlife Research Station at Helena Valley in 1966, and of which the present head is Dr. Stephen Davies. The work organized there is mainly ecological and ethological.

In marine zoology the CSIRO Division of Fisheries and Oceanography has conducted local research since 1943. Prior to that period some marine surveys had been made by the Commonwealth Government in the research trawler *Endeavour*, under H. C. Dannevig (Dannevig 1913). His studies in the Great Australian Bight extended into Western Australian waters. The biological results, including taxonomic studies on many groups, were published in six volumes of reports between 1911 and 1933 by the Commonwealth Department of Trade and Customs. The CSIRO surveys in the Fisheries Research Vessel *Warreen* (Captain C. E. Pedersen) from 1947-1949 were extended later in vessels of the Royal Australian Navy on hydrographic and plankton investigations. The Division operates in active cooperation with the State Fisheries and Wildlife Department.

The new modes of transport now available to the field worker on land, operating as a member of a well-planned team of several specialists, contrast markedly with the facilities available to their predecessors. Whitlock in 1909 travelled to Wiluna by a camel team; Carter, 30 years after he first arrived in the North-West, describes his first motor car trip in 1916. Four wheel drive vehicles and aircraft make the most

inaccessible portions of the State available to zoological survey teams and the impressive modern publications of the Museum and Department of Fisheries and Wildlife are now documenting the fauna of the furthest ends of the State.

But, curiously, the South-West corner in spite of 150 years of settlement, still provides zoological spoils of intense theoretical significance. In 1971 A. R. Main discovered *Peripatus* on the Swan Coastal Plain south of Perth (Van der Lande 1978) after it was universally believed that this creature occurred only in the Darling Range plateau. Rosen (1974) demonstrated his belief in a lengthy and elaborate paper that a diminutive fish found in a small brook near Shannon River in 1959, and named by Mees (1961) *Lepidogalaxias salamandroides*, was not a primitive galaxiid but a member of a Northern Hemisphere grouping, the esocoids, or pikes, hitherto unknown from any southern continent and presenting baffling questions as to origins. Rosen's suggested affinities have been treated with some reserve by other zoologists. However, whatever its relationships *Lepidogalaxias* must be regarded as an extraordinarily interesting survival of an ancient fauna. It occurs now in the extreme south-west corner of the State which is remarkable for the number of animal species of very circumscribed ranges—in freshwater fishes (Mees 1961), frogs (Main 1965), and freshwater crustacea of the jilgie-koonac assemblages (Riek 1967). Its present dependable climate emphasises the point made by Gentilli (1949) that throughout the period of climatic changes during the Pleistocene this has been a humid refuge. It deserves a thorough zoological survey and in groups other than birds and mammals which have been the preoccupation of many faunal surveys of the past. *Lepidogalaxias* was first picked up by casual non-professional collecting in 1959; it could so easily have remained undetected to the present day. No large area in this South-West corner should be subject to any extensive habitat despoliation—for developmental purposes—until adequate biological surveys have been made. The miscellany of information provided by Nicholls (1933) on the extent of a damp earth and freshwater fauna in the South-West, still largely unworked, lends particular cogency to his plea at the time for "an immediate and coordinated investigation" into it.

References

- Aldrich, F. (1912-1933).—Reports of the Chief Inspector of Fisheries 1911 to 1933. Government Printer, Perth (those from 1911 to 1912 printed, remainder in typescript).
- Alexander, W. B. (1914).—The history of zoology in Western Australia; discoveries in the 17th Century. *J. W. Aust. Nat. Hist. & Science Soc.* 5: 5-20.
- Alexander, W. B. (1916).—Obituary: Mr. Richard Helms. *J. Roy. Soc. W. Aust.* 1: xxviii-xxix.
- Alexander, W. B. (1916a).—History of zoology in Western Australia. Part II. 1791-1829. *J. Roy. Soc. W. Aust.* 1: 3-69.
- Alexander, W. B. (1916b).—Notes on the birds met with on the Swan River by Vlamingh in 1697. *J. Roy. Soc. W. Aust.* 1: 70-71.

- Alexander, W. B. (1917).—History of zoology in Western Australia. Part 3, 1829-1840. *J. & Proc. Roy. Soc. W. Aust.* 3: 1-33.
- Alexander, W. B. (1922).—The vertebrate fauna of Houtman's Abrolhos (Abrolhos Islands), Western Australia. *J. Linn. Soc. London* 34: 457-486.
- Austin, R. (1855).—Journal of Assistant Surveyor R. Austin in the interior of Western Australia. Government Printer, Perth.
- Baglin, F. A. (Chairman) (1922).—Report of the select committee of the Legislative Council appointed to inquire into the fishing industry. Government Printer, Perth.
- Beaglehole, J. C. (ed.) (1962).—The Endeavour Journal of Joseph Banks. Public Library of New South Wales, Sydney, vol. 2.
- Campbell, A. J. (1890).—A naturalist in Western Australia. A series of articles in the *Australasian* (Melbourne): Albany (March 1). Around Albany (March 15). Cape Leeuwin District (March 21). To Geographe Bay (March 29). In the Forests (March 29). Under the Jarrah (April 5). With feathered friends (April 12). Among the Karri giants (April 19). On the lower Swan (April 26). Rottneest Island (May 3). Champion Bay (May 10). Historic Islands (May 17). A guano station (May 31). Overland notes and conclusion (June 21).
- Chisholm, A. H. (1964).—Some early letters in Australian ornithology, *Emu* 63: 287-296, 373-382.
- Chittleborough, R. G. (1967).—Observations by the late F. Aldrich on Australian marine crayfish in captivity. *W. Aust. Nat.* 10: 162-168.
- Clark, H. L. (1923).—Some echinoderms from West Australia. *J. Linn. Soc. London* 35: 229-251.
- Cornell, C. (1974).—The Journal of Post Captain Nicolas Baudin. Libraries Board of South Australia, Adelaide.
- Daglish, H. (1906).—Report of the joint select committee appointed to inquire into the fishing industry. Government Printer, Perth.
- Dahl, K. (1926).—In Savage Australia. Philip Allan & Co. London.
- Dakin, W. J. (1914).—Fauna of Western Australia—II. The Phyllopora. *Proc. Zool. Soc. London* 1914: 293-305.
- Dakin, W. J. (1916).—Marine biology in Western Australia. *J. & Proc. Roy. Soc. W. Aust.* 1: 11-27.
- Dakin, W. J. (1916a).—A new species of Enteropneusta, *Ptychodera pelsarti*, from the Abrolhos Islands. *J. Linn. Soc. London* 33: 85-98.
- Dakin, W. J. (1919).—The Percy Sladen Trust Expeditions to the Abrolhos Islands (Indian Ocean). Report 1—Introduction. *J. Linn. Soc. London* 34: 127-180.
- Dannevig, H. C. (1913).—Notes on Australia's Fisheries with a summary of the results obtained by the F.I.S. "Endeavour". Dept. of Trade and Customs, Melbourne.
- Dendy, A. (1924).—On a collection of sponges from the Abrolhos Islands, Western Australia. *J. Linn. Soc. London* 35: 477-519.
- Drake-Brockman, H. (1963).—Voyage to Disaster. Angus and Robertson, Sydney.
- Erickson, R. (1964).—History of the Western Australian Naturalists' Club. *W. Aust. Nat.* 9: 121-152.
- Erickson, R. (1974).—History of the Western Australian Naturalists' Club. W.A. Naturalists' Club, Perth.
- Fauvel, P. (1922).—Annélides Polychaètes de l'Archipel Houtman Abrolhos (Australie Occidentale) recueillies par M. le Prof. W. J. Dakin. *J. Linn. Soc. London* 34: 487-500.
- Fraser, A. J. (1938-1939).—Annual Report of the Chief Inspector of Fisheries for the years 1937 and 1938. Government Printer, Perth.
- Freeman, D. J. (1970).—The rediscovery of the Black Grass Wren *Amytornis housei* with additional notes on the species. *Emu* 70: 193-195.
- Gale, C. F. (1900-1911).—Reports on the Fishing Industry for the years 1899 to 1910. Government Printer, Perth.
- Glauert, L. (1928).—Popular names for marsupials. Publ. Library, Mus & Art Gallery W. Aust., Mus. Leaflet No. 1.
- Glauert, L. (1934).—The distribution of marsupials in Western Australia. *J. Roy. Soc. W. Aust.* 19: 17-32.
- Glauert, L. (1948).—The ornithological collecting of Dr. L. Preiss in 1839. *W. Aust. Nat.* 1: 147-148.
- Glauert, L. (1950).—The development of our knowledge of the marsupials of Western Australia. *J. Roy. Soc. W. Aust.* 34: 115-134.
- Glauert, L. (1955).—The "new" tortoise. *W. Aust. Nat.* 5: 44-45.
- Grey, G. (1841).—Journals of two expeditions of discovery in North-West and Western Australia. T. & W. Boone, London.
- Hay, J. G. (1906).—The visit of Mr. Charles Fraser . . . to the Swan River in 1827. *J. W. Aust. Nat. Hist. Soc.* 3: 16-35.
- Hedley, C. (1916).—A preliminary index of the mollusca of Western Australia. *J. & Proc. Roy. Soc. W. Aust.* 1: 152-226.
- Heeres, J. E. (1890).—The Part borne by the Dutch in the Discovery of Australia. London.
- Hickson, S. J. (1922).—On Two Sea-pens from West Australia. *J. Linn. Soc. London* 35: 21-23.
- Holman, J. B. (1915).—Interim report of the select committee of the Legislative Assembly appointed to inquire into the whaling industry. Government Printer, Perth.
- Hogg, H. R. (1914).—Spiders from the Montebello Islands, *Proc. Zool. Soc. London* 1914: 69-92.
- Ingleton, G. C. (1944).—Charting a continent. Angus and Robertson, Sydney.
- Iredale, T. (1914).—Report on mollusca collected at the Montebello Islands. *Proc. Zool. Soc. London* 1914: 655-675.
- Ives, N. (1973).—Overnight torpidity in Australian arid-country birds. *Emu* 73: 140.
- Jenkins, C. F. H. (1965).—A history of the Royal Society of Western Australia, and its role in the community. *J. Roy. Soc. W. Aust.* 48: 33-44.
- Jenkins, C. F. H. (1978).—The Noah's Ark Syndrome (A Hundred Years of Acclimatization and Zoo Development in Australia). General Printing (West Australian Newspapers Ltd.), Perth.
- Kornweibel, A. H. (1973).—Apollo and the Pioneers. Music Council of Western Australia, Perth.
- Leslie, H. A., (Chairman) (1948-1949).—Royal Commission into the Fishing Industry. Western Australian Parliamentary Library (in typescript).
- Lindley, J. (1839).—A sketch of the vegetation of the Swan River Colony. James Ridgeway, London.
- Lindner, F. (1941).—Contributions to the morphology and the taxonomy of the Branchiopoda Anostraca. *Zool. Bidrag Fran Uppsala* 20: 101-302.
- Main, A. R. (1965).—Frogs of Southern Western Australia. Western Australian Naturalists' Club, Perth. Handbook No. 8.
- Major, R. H. (1859).—Early Voyages to Terra Australis, now called Australia. London.
- Mees, G. F. (1961).—Description of a new fish of the family Galaxiidae from Western Australia. *J. Roy. Soc. W. Aust.* 44: 33-38.
- Meise, W. (1951).—Notes on the ornithological collections of Preiss in the Swan River Colony, 1838-1941. *Emu* 51: 148-151.
- Michaelsen, W. (1908).—First report upon the publications of the "Hamburger südwest-australische Forschungsreise, 1905". *J. W. Aust. Nat. Hist. Soc.* 5: 6-25.
- Michaelsen, W. (1911).—Second abstract of the reports of the German expedition of 1905 to South-Western Australia. *J. Nat. Hist. & Science Soc. W. Aust.* 3: 137-163.

- Michaelsen, W. (1914).—Third abstract of the reports of the German expedition of 1905 to South-Western Australia. *J. Nat. Hist. & Science Soc. W. Aust.* 5: 65-107.
- Michaelsen, W. and Hartmeyer, R. (Eds) (1907-1930).—Die Fauna Südwest-Australiens. G. Fischer, Jena.
- Milner, D. F. (1929).—Description of two new species of anostracan Phyllopoda from Western Australia. *J. Roy. Soc. W. Aust.* 15: 25-35.
- Montague, P. D. (1913).—The Monte Bello Islands. *Geographical J.* 42: 34-44.
- Montague, P. D. (1914).—A report on the fauna of the Monte Bello Islands. *Proc. Zool. Soc. London* 1914: 625-652.
- Moore, G. F. (1832).—Extracts from letters, written by a gentleman lately established on the Swan River, Western Australia. Dublin.
- Moore, G. F. (1842).—A descriptive vocabulary of the language in common use amongst the Aborigines of Western Australia. London.
- Moore, G. F. (1884).—Diary of ten years eventful life of an early settler in Western Australia. M. Walbrook. London (includes a reprint of the previous item).
- Musgrave, A. (1932).—Bibliography of Australian entomology 1775-1930. *Roy. Zool. Soc. N.S.W.*: Sydney.
- Nicholls, G. E. (1932).—Composition and biogeographical relations of the fauna of Western Australia. *Rept. Aust. & N.Z. Assoc. Adv. Sc.* 21: 93-138.
- Nicholls, G. E. (1943).—The Phreatoicidea. Part I. *Papers and Proc. Roy. Soc. Tas.* 1942: 1-145.
- Nicholls, G. E. (1944).—The Phreatoicidea. Part II. *Papers and Proc. Roy. Soc. Tas.* 1943: 1-157.
- O'Donoghue, C. H. (1924).—Report on Opisthobranchiata from the Abrolhos Islands, Western Australia, with description of a new parasitic copepod. *J. Linn. Soc. London* 35: 521-579.
- Ogilvie-Grant, W. R. (1909).—On a collection of birds from Western Australia, with field notes by Mr. G. C. Shortridge. *Ibis* (Ser 9) 3: 650-689.
- Rathbun, M. J. (1914).—Stalk-eyed crustaceans collected at the Monte Bello Islands. *Proc. Zool. Soc. London* 1914: 653-664.
- Riek, E. F. (1967).—The freshwater crayfish of Western Australia (Decapoda: Parastacidae). *Aust. J. Zool.* 15: 103-121.
- Robson, G. C. (1914).—Cephalopoda from the Monte Bello Islands. *Proc. Zool. Soc. London* 1914: 677-680.
- Rogers, A. E. F. (1975).—Movements of Wedge-tailed Shearwaters off the coast of New South Wales. *Emu* 75: 178-180.
- Rosen, D. E. (1974).—Phylogeny and zoogeography of salmoniform fishes and relationships of *Lepidogalaxias salamandroides*. *Bull. Amer. Mus. Nat. Hist.* 153: 265-326.
- Sayce, O. A. (1903).—The Phyllopoda of Australia. *Proc. Roy. Soc. Vic.* 15: 224-261.
- Serventy, D. L. (1957).—Ludwig Glauert—Museum director and naturalist. *W. Aust. Nat.* 5: 148-165.
- Serventy, D. L. (1967).—Obituary: W. B. Alexander. *W. Aust. Nat.* 10: 139-148.
- Serventy, D. L. (1968).—William Ayshford Sanford: architect and naturalist. National Trust Newsletter, Perth, September 10: 6-8.
- Serventy, D. L. (1970).—Torpidity in Australian birds. *Emu* 70: 201-202.
- Serventy, D. L. (1972).—A historical background of ornithology with special reference to Australia. *Emu* 72: 41-50.
- Serventy, D. L. (1972a).—Causal ornithogeography of Australia. *Proc. XVth Int. Ornith. Congress* 1970: 574-584.
- Serventy, D. L. (1973).—Origin and structure of Australian bird faunas. In *Birds of Australia*, by J. D. Macdonald. Reed. Sydney. pp. 21-28.
- Serventy, D. L. (1973a).—Organization and administration of ornithology. *Emu* 73: 206-209.
- Serventy, D. L. and Whittell, H. M. (1976).—Birds of Western Australia. University of Western Australia Press, Perth.
- Shortridge, G. C. (1909).—An Account of the Geographical Distribution of the Marsupials and Monotremes of South-West Australia. . . . *Proc. Zool. Soc. London* 1909: 803-848.
- Söderberg, R. (1918).—Results of Dr. E. Mjöberg's Swedish Scientific Expedition to Australia 1910-1913. XVIII. Studies of the Birds in North West Australia. *Klg. Sv. Vetenskapsakad. Handl.* [n.s.] 52: 1-116.
- Spencer, Baldwin. (1896).—Summary of the Zoological . . . Results of the Expedition. In Report on the work of the Horn Scientific Expedition to Central Australia. Vol. 1. Dulau and Co. London.
- Stormon, E. J. (1977).—The Salvado Memoirs. University of Western Australia Press, Perth.
- Tattersall, W. (1922).—The Percy Sladen Trust Expedition to the Abrolhos Islands (Indian Ocean), under the leadership of Prof. W. J. Dakin. Amphipoda and Isopoda. *J. Linn. Soc. London* 35: 1-19.
- Thompson, Lindsay. (1898).—Report on the Marine Fisheries on the South and South-Western coasts of the colony of Western Australia. Government Printer, Perth.
- Tyler, P., and Ross, K. (1977).—Abraham Leeman—castaway. *Westerly*, No. 1: 35-60.
- Van der Lande, V. (1978).—The occurrence, culture and reproduction of *Peripatoides gilesii* Spencer (Onychophora) on the Swan Coastal Plain. *W. Aust. Nat.* 14: 29-36.
- Vines, F. (1968).—Thomas Carter, Ornithologist. *Early Days. J. and Proc. Roy. W. Aust. Hist. Soc.* 6: 7-21.
- Watson, E. L. Grant. (1968).—Journey under the southern stars. Abelard-Schuman. London and New York.
- Whitley, G. P. (1970).—Early history of Australian zoology. *Roy. Zool. Soc. N.S.W.*: Sydney.
- Whitley, G. P. (1975).—More early history of Australian zoology. *Roy. Zool. Soc. N.S.W.*: Sydney.
- Whittell, H. M. (1941).—A review of the work of John Gilbert in Western Australia. Parts I-III. *Emu* 41: 112-129; 216-242; 89-305.
- Whittell, H. M. (1951).—A review of the work of John Gilbert in Western Australia. Part IV. *Emu* 51: 17-29.
- Whittell, H. M. (1954).—The Literature of Australian Birds. Paterson Brokensha, Perth.
- Whittell, H. M. (1954a).—John Gilbert's notebook on marsupials. *W. Aust. Nat.* 4: 104-114.
- Wolf, E. (1911).—Phyllopoda. In *Die Fauna südwest-Australiens*, ed. W. Michaelsen and R. Hartmeyer. Vol. 3, part 9.
- Woodward, B. H. (1903).—The Western Australian Museum and Art Gallery, Perth. *The Museums Journal for December 1903*: 179-187.